

# XIAO: a soft X-ray telescope for the SVOM Mission

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## ABSTRACT

The study of Gamma-ray bursts (GRBs) is a key field to expand our understanding of several astrophysical and cosmological phenomena. SVOM is a Chinese-French Mission which will permit to detect and rapidly locate GRBs, in particular those at high redshift, and to study their multiwavelength emission. The SVOM satellite, to be launched in 2013, will carry wide field instruments operating in the X-/ $\gamma$ -ray band and narrow field optical and soft X-ray telescopes. Here we describe a small soft X-ray telescope (XIAO) proposed as an Italian contribution to the SVOM mission. Thanks to a grazing incidence X-ray telescope with effective area of  $\sim 120 \text{ cm}^2$  and a short focal length, coupled to a very compact, low noise, fast read out CCD camera, XIAO can substantially contribute to the overall SVOM capabilities for both GRB and non-GRB science.

**Keywords:** Gamma-ray bursts, X-rays, gamma-rays

## 1. THE SVOM MISSION

The study of Gamma-ray bursts (GRBs), extremely luminous transient sources appearing in the sky when black holes are born in the explosions of massive stars or in the merging of compact stellar objects, has become a key field to expand our understanding of several astrophysical and cosmological phenomena. These include, e.g., the evolution of the young universe, the history of star formation, the metal enrichment of galaxies, the mechanisms driving supernova explosions, the physics of ultra-relativistic shocks.

SVOM (Space-based multi-band astronomical Variable Objects Monitor) is a mission, developed in collaboration by the Chinese and French space agencies (CNSA and CNES), for the study of GRBs and other high-energy transients. SVOM is designed to detect and rapidly locate all kinds of GRBs, in particular those at high redshift, and to study their emission on a broad spectral range, from the visible to the MeV region. This will be possible thanks to a satellite payload composed of wide field X-/ $\gamma$ -ray instruments and narrow field optical and soft X-ray telescopes, complemented by dedicated ground telescopes and a system for rapid distribution of the GRB positions.

Building on the successful experience of Swift,<sup>1</sup> the SVOM operations are based on the following steps: (i) GRB detection with a wide field gamma-ray imaging instrument able to derive on-board its localization with a few arcmin precision<sup>2</sup>; (ii) the GRB position is immediately transmitted to ground through a network of ground stations and at the same time the satellite slews rapidly to position the GRB in the narrow fields of view of its X-ray and optical telescopes, which will study the afterglow and provide refined coordinates.

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SVOM will adopt an optimized observation strategy,<sup>3</sup> based on antisolar pointing and avoidance of the galactic plane, in order to permit follow-up observations with large telescopes and maximize the number of redshift measurements. The knowledge of redshift and the determination of the spectral shape over an extended energy range are in fact essential to derive the bursts energetics and to study the empirical correlations used for cosmological studies.

The SVOM satellite will carry the following instruments:

- *Camera X and Gamma (CXG)*: a wide field instrument operating in the 4-300 keV energy range, with a field of view of 2 sr and a location accuracy of several arcmin. This instrument, providing the GRB triggers and initial localizations, is based on an array of CdTe pixels with a sensitive area of 1000 cm<sup>2</sup> coupled to a coded mask aperture. It is based on the instrument originally proposed for the Eclairs satellite.<sup>4</sup>
- *XIAO*: a narrow field soft X-ray telescope to locate and study the GRB afterglows (see next Section).
- *Visual Telescope (VT)*: an optical telescope operating in the 400-950 nm range, with a field of view of  $\sim 21'$ , reaching a sensitivity of  $V \sim 23$  magnitudes in 300 s exposure times.
- *Gamma-ray Burst Monitor (GRM)*: a non-imaging spectrometer to measure the GRB spectra in the 50 keV-100 MeV energy range over a wide field of view

SVOM will be placed in a near earth orbit, of  $\sim 600$  km altitude and  $\lesssim 30^\circ$  inclination. The GRB coordinates, and a small set of relevant information, will be transmitted on ground in real time by means of a network of VHF stations, as successfully done in the past by the HETE-2 satellite. The bulk of the data will be downloaded (a few times per day) when the satellite is in contact with the main ground station(s). The SVOM satellite will be launched in 2013, with the goal to detect and precisely locate about 200 GRBs in a nominal mission duration of 2.5 years.

## 2. XIAO SCIENTIFIC PERFORMANCES

XIAO (X-ray Imager for Afterglow Observations) is a small and light X-ray telescope designed with the main objective of significantly improving the GRB locations obtained on board the satellite, through a prompt identification of the afterglows. This can be achieved with a grazing incidence mirror operating in the soft X-ray band.

Taking into account the tight constraints of mass and dimensions, an optimized design based on a Wolter I mirror with a short focal length coupled to a fast read out, low noise CCD detector has been chosen. A light structure in carbon fiber will connect the Mirror Module and CCD Camera Units, providing the required stiffness and shielding the CCD from optical radiation. The structure will also provide the interfaces to mount the XIAO telescope on the satellite Payload Interface Module. A dedicated electronics will compute in real time the source positions to be immediately transmitted to the ground. A conceptual design of the main XIAO telescope elements is shown in Fig. 1.

XIAO is required to cover a field of view of  $\sim 25$  arcmin diameter, in order to include, with a safe margin, the initial GRB error region provided by the CXG instrument. A moderate angular resolution is adequate, considering that most of the observed bursts will lie at high galactic latitude, where no source confusion is expected. This translates in a requirement of  $\sim 30''$  (Half Energy Diameter, HED) for the XIAO point spread function.

On the other hand, a good localization accuracy is one of the main drivers of the XIAO design. The source localization accuracy,  $\sigma_{POS}$ , is linked to the width of the instrument point spread function by  $\sigma_{POS} \sim k \times \frac{\sigma_{HED}}{\sqrt{N}}$ , where  $k$  is a constant depending on the instrument point spread function,  $\sigma_{HED}$  is the width of the point spread function, and  $N$  is the number of detected photons. This relation, supported by experience with similar X-ray telescopes, is confirmed by simulations of the XIAO instrument, as shown in Fig. 2. If only statistical errors are considered, localizations at the arcsecond level can be obtained with XIAO as soon as few hundreds of X-ray afterglow photons are collected. In practice, for most cases the localization accuracy achievable on board will be

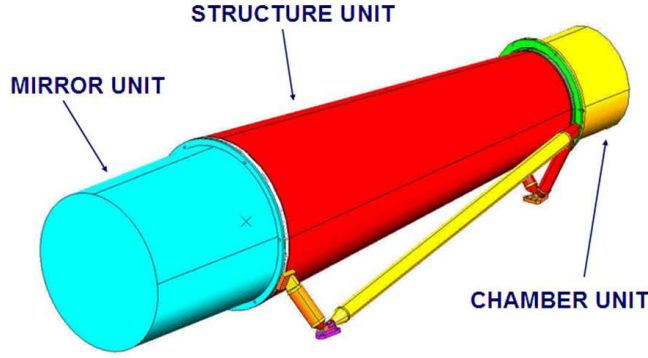


Figure 1. Conceptual design showing the main elements of the XIAO telescope. The radiator and the digital electronic box are not shown. (courtesy A. Stevoli - TAS-I)

limited by systematics affecting the attitude reconstruction. Quick look ground analysis, also exploiting the VT data, will permit a reduction of the systematic effects and lead to more accurate positions.

The expected throughput of XIAO is a function of the source spectral properties, and in particular of the interstellar absorption. Assuming a power law spectrum with photon index  $\Gamma=2$  and  $N_H = 10^{21} \text{ cm}^{-2}$ , with the mirror effective area and the CCD Camera described below, we expect  $1 \text{ count s}^{-1}$  for a 2-10 keV flux of  $3 \cdot 10^{-11} \text{ erg cm}^{-2} \text{ s}^{-1}$ . The expected sensitivity is shown in Fig. 3. Note that, thanks to the short focal length, the particle induced background in the resulting very small source extraction region, will be very small. Thus, even for relatively long exposure times, the XIAO sensitivity will not be background-dominated.

In Fig. 4 we have plotted a sample of X-ray afterglow light curves converting the fluxes observed with the Swift/XRT instrument to the expected XIAO count rate. In this conversion we have properly taken into account the spectral parameters of each afterglow. The figure shows that XIAO has a sensitivity adequate to provide precise localizations for most GRBs, considering that X-ray afterglows are observed in  $\sim 95\%$  of the GRBs. Detailed studies of the brightest afterglows will also be possible during follow-up observations.

Table 1 summarizes the scientific performances expected for XIAO.

Table 1. Expected performances of the XIAO soft X-ray telescope

Energy Range	0.5 – 2 keV
Field of view	27' diameter
Angular resolution	30'' (Half Energy Diameter)
Location accuracy	$\sim 10''$ for a source at $5\sigma$
	$\lesssim 5''$ for a source at $>10\sigma$
Sensitivity ( $5\sigma$ )	$\sim 10 \text{ mCrab}$ in 10 s
	$\sim 10\text{-}20 \text{ }\mu\text{Crab}$ in 10 ks
Energy resolution	$\sim 150 \text{ eV}$ (FWHM at 1.5 keV)
Time resolution	$\sim 10 \text{ ms}$

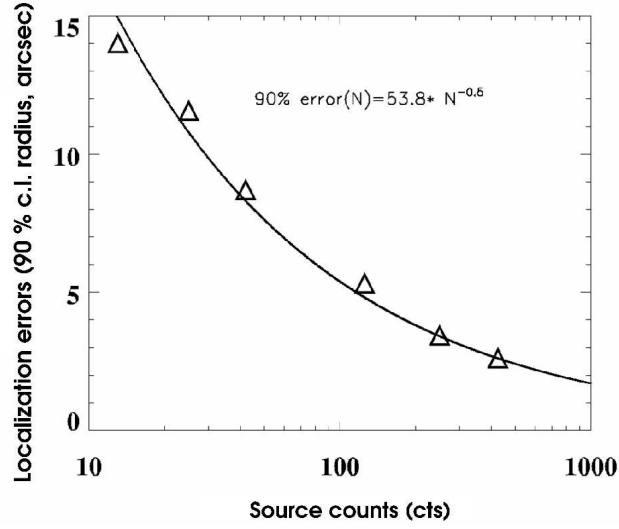


Figure 2. XIAO source location accuracy as a function of the number of detected photons. The data points have been obtained with simulations assuming a point spread function with HED=30". The line is the best fit with a function  $\sigma_{POS} \propto N^{-0.5}$ .

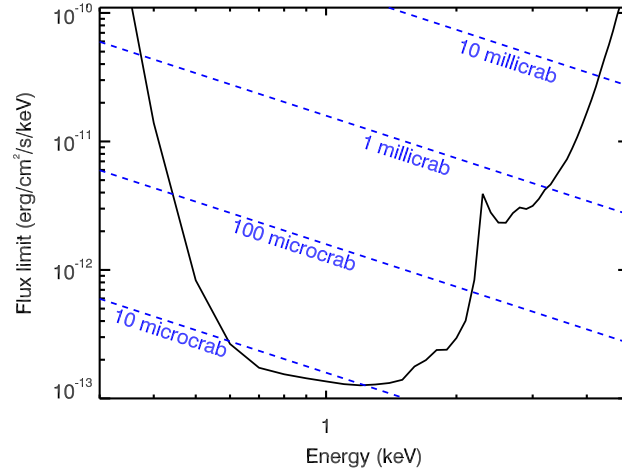


Figure 3. Expected sensitivity of the XIAO telescope ( $5\sigma$  detection in 10 ks), computed assuming a 30" Half Energy Diameter, a source extraction circle of 15" radius, and an energy bin  $\Delta E = E/2$ .

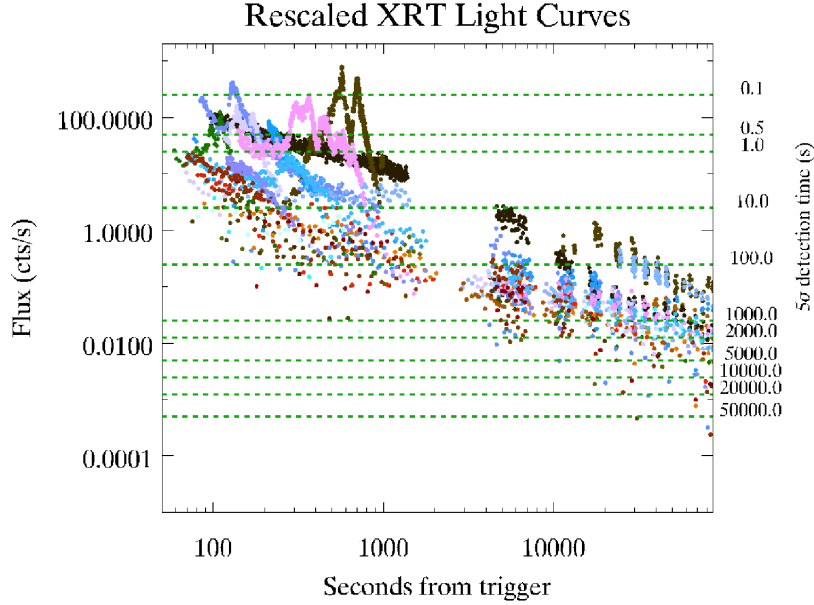


Figure 4. Expected XIAO light curves for a sample of representative GRB afterglows. The horizontal lines give the XIAO  $5\sigma$  sensitivities corresponding to the integration times marked on the right axis.

### 3. XIAO BASELINE DESIGN

#### 3.1 Mirror Module Unit

The XIAO Mirror Module Unit comprises the X-ray optics with the associated mechanical structure, a thermal baffle, and a front cover.

The optical design of the mirrors consists of 6 Wolter I shells with focal length of 830 mm. The 6 shells have the same length equally shared by parabola (300 mm) and hyperbole (300 mm). Diameters range from 250 to 144 mm, and the thickness is  $\sim 300 \mu\text{m}$  for all the shells. The present design is the result of an optimization procedure where the most severe requirements were the total weight allocated to the shells ( $\lesssim 5 \text{ kg}$ ) and the maximum length of the telescope. The optimization has been performed by evaluating the telescope effective area over the field of view weighted by the GRB position accuracy expected from the CXG (approximately a Gaussian with  $\sigma \sim 4'$ ). The short focal length gives a plate scale  $\sim 4' \text{ mm}^{-1}$ , thus the required field of view can be efficiently covered with a very small detector.

The mirrors will be produced by replicating superpolished mandrels by means of electroformed Nickel shells. This is a well consolidated technology developed for BeppoSAX and subsequently applied with success to XMM-Newton and Swift/XRT. The shells will be integrated by means of a single spider with eight arms positioned on the front pupil as shown in Fig. 5. With a shell coating in gold, this configuration is providing the effective area shown in Fig. 6.

A thermal baffle is placed in front of the mirror to keep it at an operating temperature of  $\sim 20^\circ$  avoiding gradients that would lead to deformation of the optics and a degradation of the imaging performance. A cover is required to avoid contamination during ground activities, launch and early orbital phases.

#### 3.2 CCD Camera Unit

The X-ray photons focused by the mirror unit will be detected by a small, fast scan, X-ray CCD operating in photon counting mode and placed in the focal plane. A CCD Camera Unit (CCU) will host the detector and all the elements required for operating the sensor. The CCU will include: a detector sub-system (CCD and thermal control based on a Thermo Electric Cooler (TEC)), the Proximity and Front-End Electronics, and a shielding sub-system (proton shield and shutter).

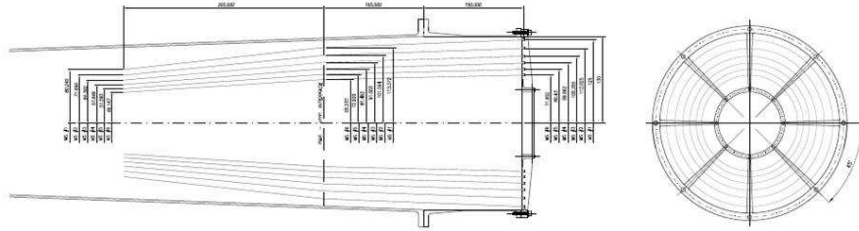


Figure 5. Preliminary design of the XIAO X-ray optics (courtesy R.Buzzi - BCV).

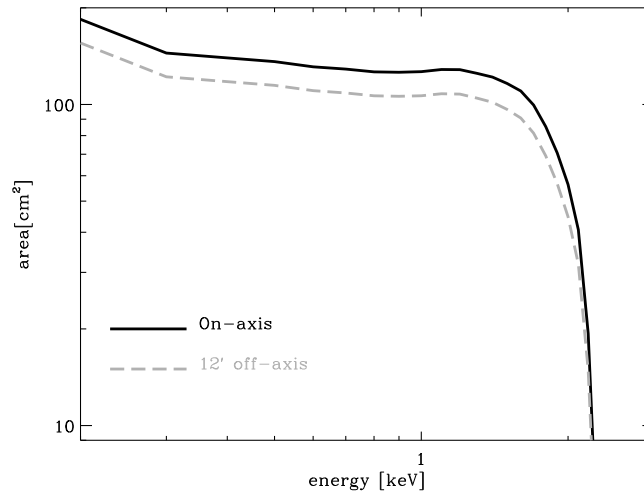


Figure 6. The effective area expected for the current optical design, taking into account a loss of 10% due to the spider occultation. The solid line is for on-axis sources, while the dashed line refers to an off-axis angle of 12'.

The baseline detector has been preliminarily identified in a customized, X-ray optimized, version of the e2V CCD67 sensor. The device is a frame transfer CCD with active area of  $256 \times 256$  pixels (pixel size  $26 \mu\text{m}$ , corresponding to  $6.5''$  for the XIAO focal length). This device is characterized by being suitable for high frame rate readout, thanks to the two output nodes and amplifiers which allow readout frequency up to  $5 \text{ MHz}$  (corresponding to  $150 \text{ frames s}^{-1}$ ). The sensor is available in a back-illuminated, thinned version. Due to the soft energy range of the telescope ( $\lesssim 2 \text{ keV}$ ), a thickness of  $\sim 25 \mu\text{m}$  has been chosen.

In order to allow photon counting operation with low pile-up even in the early stages of the GRB afterglow, when the incoming flux can be high, the CCD should be read at the highest frame rate. However, a trade-off has to be made with the readout noise: higher noise affects the performance of the detector not only in terms of energy resolution, which is a secondary parameter for XIAO, but, most important, in terms of sensitivity at low energy. Based on these considerations, a frame rate of  $100 \text{ frames s}^{-1}$  is considered the goal. Taking into account the PSF of the mirrors, this translates in a 10% loss of linearity under a count rate of  $\sim 200 \text{ counts s}^{-1}$  from a point-like source.

Active cooling to an operative value of about  $-65^\circ$  will be provided by means of a TEC coupled through a cold finger to a radiator mounted on the cold side of the satellite. A fixed proton shield will protect the detector from the flux of charged particles, and a fixed optical/UV blocking filter will be placed above the CCD, in order to reduce the optical loading of the detector. Moreover, a shutter will allow closing the camera, preventing the electromagnetic radiation to reach the detector (for testing and calibration purposes, other than for safety). The shutter will also provide protection from low energy particles during SAA crossings. A calibration source could be allocated on the backside of the shutter seen by the CCD.

The camera will be enclosed in a vacuum housing, to allow ground tests and launch in vacuum. The housing will be hermetically sealed by a door, which will be operated on-ground during tests and “one shot” on-orbit. A vacuum valve will allow on ground evacuation or gas filling, e.g. with dry nitrogen during storage. The Camera Unit will also contain part of the electronics, as described below.

### 3.3 Electronics

The XIAO electronics subsystem includes the front end electronics of the CCD and a Digital Processing Unit (DPU), which controls the XIAO telescope, handling instrument power distribution, telemetry and telecommand management, scientific data acquisition and processing, and I/F management.

#### 3.3.1 Front End Electronics

The CCD Front End Electronics (FEE) will include two main blocks: an Analog Front-End Electronics (AFEE) and a Digital Front-End Electronics (DFEE).

The AFEE will include the CCD bias generator, clock drivers, and two analog signal processing chains (one for each output node). The main guideline in the AFEE design is to maintain its contribution to the readout noise negligible respect to the CCD on-chip amplifier noise. This translates in the request of noise  $\lesssim 10$  electrons rms. Part of the electronics will be located directly near the CCD to limit the noise, in particular: preamplifiers, bias generators and clock drivers will be located as close as possible to the CCD (Proximity Electronics). Electrical connections between the proximity FEE board and the sensor will be made via two flexi connectors that also provide a thermal break.

The DFEE will include the CCD controller and the components for the real-time pre-processing of the images. The latter will work only when the camera is operated in photon counting mode and will implement the following tasks: (i) “valid” X-ray events pattern recognition (rejecting cosmic ray traces and other contaminants); (ii) bright pixel rejection; (iii) events coordinates computation; (iv) energy evaluation (in case of splitted events by summing energy deposited in all the pixels involved). The output of the image pre-processing is a list of X-ray events coordinates, with additional information about timing and energy, which is sent to the DPU.

### 3.3.2 Data Processing Unit

The DPU will provide all the usual services required to operate the instrument, such as management of the secondary voltage lines, actuators (TEC, heaters, sensors, valves and mechanisms), management of data and housekeeping, etc... A microprocessor based block will be in charge of TM/TC management (from/to S/C and CCU) and thermal control.

In addition to these “standard” functions, the DPU is in charge of the real time computation of the GRB coordinates when XIAO is in the “GRB Localization” mode. This is done by elaborating the event coordinates as generated by the DFEE (which will operate in “photon counting mode”) in order to localize the spot corresponding to the GRB afterglow and then computing the coordinates (and associated uncertainties) of its centroid.

## 4. SCIENCE WITH XIAO

### 4.1 Scientific objectives for GRBs

To reach the main SVOM scientific goals (e.g. population studies and cosmology with GRBs), the presence on board of an X-ray telescope like XIAO is mandatory. In fact an X-ray telescope observing the afterglows is needed to locate GRBs with sufficient accuracy (down to few arcsec) required to promptly identify an optical counterpart and measure the redshift. XIAO will provide an intermediate step between the first localizations at several arcmin level given by the CXG and the precise localizations that can in principle be achieved with the optical telescope. It must also be considered that about half of the bursts are optically dark.<sup>5</sup> Particularly interesting will be the  $z > 5$  bursts (drop-outs in optical) that SVOM is expected to detect thanks to the CXG energy range extending to low energy ( $\sim 4$  keV). In addition to the GRB localization tasks, there are also several specific objectives for which XIAO is essential. In the following we highlight a few of them.

XIAO extends the SVOM spectral coverage down to at least 0.5 keV, thus complementing the energy range of the CXG and GRM. For very long bursts, or bursts triggered on precursors, XIAO will see the prompt emission. This will allow to constrain the spectral parameters including the peak energy<sup>6</sup> which is the crucial parameter to understand the GRB physics and do cosmology. The study of the GRB class of X-ray Flashes<sup>7</sup> will largely benefit from XIAO observations.

Spectral fitting of the X-ray afterglow with XIAO will determine the GRB intrinsic hydrogen column. Swift showed that this can be a tool to identify high redshift bursts<sup>8</sup> since the photons from these sources are emitted at higher energies, less affected by absorption. The pre-selection of high redshift candidates can be useful to tune the ground-based and space follow up.

XIAO will shed light on the physics of the afterglow which is now an open issue. Indeed, several bursts show a different behavior in the optical and X-rays, still not convincingly explained.<sup>9</sup> Combined with the VT and ground-based optical/IR follow up, XIAO will give light curves and time resolved spectra of the different (early and late) phases of the afterglow emission. In particular, it will be possible to study the issue of (a)chromatic breaks, crucial to derive the collimation angle of the jet (hence its true energy).<sup>10</sup>

XIAO will detect the X-ray flares superimposed to the continuous afterglow emission. Their nature is not understood: they could correspond to the late time accretion of a fragmented disk or to slow shells.<sup>11</sup> In either case the energetics and spectra of the flares can distinguish among the proposed interpretations. Complemented by the high-energy detection by the CXG and GRM, XIAO will prove if flares have the same nature of earlier prompt pulses, thus unveiling the possible accretion modes/regimes at the hearth of the central engine.<sup>12</sup>

A few cases of low luminosity very long GRBs have been discovered recently and have been proposed to be a distinct class of bursts, possibly with a different central engine: a magnetar instead of a black hole.<sup>13</sup> They emit most of their energy in the soft X-ray band where XIAO is sensitive. One of these bursts (GRB 060218<sup>14</sup>) also showed a thermal black body component with a temperature of 0.2 keV whose nature is debated (supernova shock breakout or fireball matter-radiation decoupling).

XIAO will give a series of snapshots of the chemical composition of the circumburst medium (through absorption edges and features<sup>15</sup>). This is particularly important because it is related to the apparent contradiction of a uniform circumburst medium (as suggested by the present observations) and the expectation of a stratified



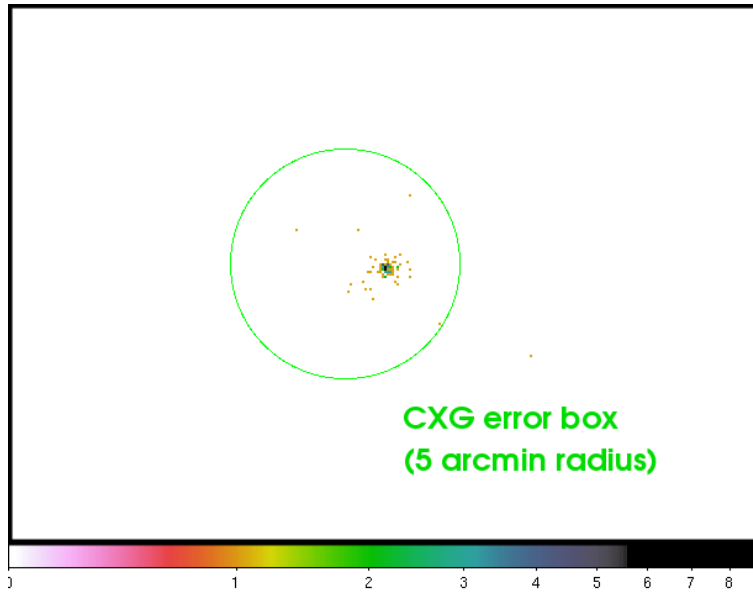


Figure 7. Simulated image of the afterglow of GRB 050904 as would have been seen by XIAO 160 s after the trigger. The green circle shows a representative example of the initial localization accuracy obtained with the CXG (radius  $5'$  in the case of this high fluence GRB). With this first image (2.5 s integration time) XIAO gives an error circle with  $3.7''$  radius.

wind profile (produced by a Wolf-Rayet progenitor star<sup>16</sup>). Moreover, it gives information on the dust-to-gas ratio in the vicinity of the bursts related to the optical extinction and X-ray absorption.

XIAO is important to detect and characterize low luminosity, long, soft and nearby GRBs of the kind of GRB 060218.<sup>14</sup> Thanks to its low energy range, the SVOM CXG can reveal a larger number of these events, that were not detected by BATSE and only marginally by BAT/Swift, and XIAO will be crucial in localizing and studying their X-ray emission. The importance to study this class of bursts stems out from the recent proposed association<sup>17</sup> of ultra high energy cosmic rays ( $E > 57$  EeV). If true this would make these sources the most energetic accelerators of cosmic particles, solving a more than 40-years-long debate.

Finally, as an example of the XIAO capabilities, we present a simulated observation of the GRB 050904,<sup>18</sup> the burst with the highest measured redshift ( $z=6.3$ ). We used the X-ray light curve and spectrum measured by Swift/XRT and assumed a slew time of 160 s to reach a stabilized pointing with the GRB error region in the XIAO field of view. Integrating the first 2.5 seconds of the XIAO data we obtain the image shown in Fig. 7, which contains about 120 afterglow photons. Analysis of this image with a simple centroid algorithm, representative of what could be implemented on board, results in a localization uncertainty of  $\sim 4''$  radius. The high read out frequency of the XIAO CCD allows to carry out all the observations in photon counting mode. Thus, contrary to the case of Swift/XRT, full timing and energy information is available for the counts in the first image. The Swift spectral analysis of this bright afterglow was complicated by the effects of pile-up and changing CCD modes. These issues will be much less important for XIAO.

## 4.2 Non-GRB Science

Based on current estimates for GRB trigger rate and observing efficiency, we may expect that only a fraction of the SVOM observing time will be devoted to GRBs. To maximize the science outcome of the mission, it is thus very important to plan a rewarding program of non-GRB science observations, that in any case, should not impact on the mission requirements for GRB detections and follow-up study.

Therefore non-GRB observations should (i) comply with the SVOM optimized pointing strategy and (ii) be interrupted whenever a GRB trigger occurs. The first point limits the fraction of the sky which may be investigated with a narrow-field instrument such as XIAO. On the other hand, it allows to perform observations of the same target for a rather long time interval (up to more than one month). Thus, multiwavelength, long

term, almost uninterrupted monitoring of variable sources can be identified as a unique capability of SVOM, setting the case for unprecedented studies of different classes of astrophysical sources.

The coordinated use of XIAO and the VT on board SVOM will allow to perform truly simultaneous X-ray and optical observations, something which is not easily implemented by coordinating satellite and ground based telescopes. It will thus be possible to assess the amplitude of variability over an extended energy range, as well as possible correlations between the different bands. The XIAO telescope, thanks to its good sensitivity capabilities, can drive the selection of the main topics of non-GRB science for SVOM. We describe in the following a few of such possible science themes.

#### 4.2.1 Active Galactic Nuclei

Active Galactic Nuclei come in a large diversity of manifestations. Time variability and complex, rich spectral energy distributions (SED) are the rule. Among AGN targets for XIAO, we may list sources as different as blazars, Narrow-Line Seyfert 1 (NLS1) galaxies and Low-Ionization Narrow Emission-line Regions (LINERs).

Blazars are very powerful sources. Their emission, dominated by an ultrarelativistic jet powered by the central supermassive black hole, extends from radio to TeV energies and shows a dramatic variability at all frequencies. Several bright blazars will be easily observed by XIAO. As an example, correlating the sky region accessible to SVOM in the optimal pointing strategy with sources in the ROSAT Bright Survey (hereafter RBS<sup>19</sup>), we found 16 BL-Lac sources and 10 flat Spectrum Radio Quasars with a visibility ranging from 6 to 36 days. XIAO observations, coupled to the VT data, will probe the SED on a day-by-day basis which, in synergy with simultaneous available GLAST observations, will be crucial to test and discriminate models for jet high energy emission.

NLS1 are poorly understood sources which are believed to host relatively low-mass black holes, experiencing a very high accretion rate. Such a view will be tested with XIAO and the VT thanks to systematic monitoring of dozens of NLS1 - including, e.g., 7 sources from the RBS.

LINERs are low-luminosity sources, possibly a scaled-down version of Seyfert Galaxies (as for the accretion rate). It is not even clear if they are 'Active' at all. XIAO and VT data will assess the SED and its variability (if any) for at least 10 sources with a flux larger than a few  $10^{-13}$  erg cm<sup>-2</sup> s<sup>-1</sup> (9-21 days of visibility) and will allow to assess their nature.

#### 4.2.2 Active Stars

Stellar flares are the most dramatic manifestation of magnetic activity in stellar coronae.<sup>20</sup> The study of stellar flares is crucial in order to understand the processes driving the generation of stellar magnetic fields, stellar magnetic activity, and the mechanisms of coronal heating. Observations of flares from stars of different spectral classes allow to investigate the dependence of such mechanisms on stellar parameters such as mass, temperature, gravity, rotation period, age.

SVOM will allow to collect simultaneous high temporal resolution data in the optical and soft X-ray range for a significant sample of stellar flares. Up to now, observations of this kind have been possible only in very few cases, owing to the difficulties in coordinating strictly simultaneous observations with satellite and ground telescopes. The study of different time scales for the flares as a function of energy, as well as of the broad band time-resolved spectral shape, will be very important to test the current models. SVOM will also be able to detect superflares and to perform multiwavelength follow-up studies of such rare, very energetic events, which show non-thermal emission up to  $\sim 200$  keV. There are 50 bright stars in the RBS with visibility in the 7-29 day range, according to the SVOM nominal pointing law. It will be particularly interesting to monitor the most active members of such sample. For instance, dMe stars and RS CVn systems, with a rate of detectable flares up to  $\sim 1$  per hour, will be excellent targets for XIAO.

### 4.2.3 Cataclysmic variables

Cataclysmic variables (CVs) are binary systems featuring a white dwarf accreting matter from a companion star. There is a rich phenomenological variety of CVs, mainly depending on the intensity of the magnetic field of the accreting white dwarf. In any case, CVs emit from the infrared to hard X-rays with a dramatic time variability.<sup>21</sup> CVs are valuable laboratories to study accretion mechanisms in a large range of physical conditions (as for the magnetic fields and the accretion rates). Within the sky region accessible with the optimized antisolar pointing, there are 42 CVs listed in the CV catalog.<sup>22</sup> Six of them are very bright in X-rays and are listed in the RASS-BSC. Among CVs, dwarf novae will be an interesting target. Such sources show outbursts with a recurrence time scale ranging from about one week to several months. The standard model - elaborated on the basis of optical data alone - explains the large outbursts with the development and propagation of an instability in the accretion disc. SVOM will allow simultaneous observations from the IR to hard X-rays, probing essentially all the emitting regions of such systems (from the outer region of the disk to the so-called boundary layer). In particular, the observation of the onset of the outburst will be crucial to test and improve the current disk instability model.

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